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VERIFICATION OF TRANSLATION

Sir:

I, Isamu Ogoshi, having been warned that willful false statements and the like are punishable by fine or imprisonment or both, under section 1001 of Title 18 of the United States Code, and may jeopardize the validity of the above-captioned application and any patent issuing thereon, declare:

(1) I am a patent attorney authorized to practice law in Japan and am engaged in the practice of law with OGOSHI International Patent Office at Toranomon 9 Mori Bldg. 3F, 2-2, Atago 1-Chome, Minato-ku, Tokyo 105-0002, Japan.

(2) I am fluent in the Japanese and English Languages.

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(3) I have reviewed the attached translation, and certify that it is an accurate English translation of the Japanese language international application of Yasuhiro Yamakoshi and Ryo Suzuki filed on October 14, 2004 and given International Application No. PCT/JP2004/015115.

(4) All of the statements made herein of my own knowledge are true and all statements made herein on information and belief are believed to be true.

April 11, 2006	Isamu Ogoshi
Date	Isamu Ogoshi

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NICKEL ALLOY SPUTTERING TARGET AND NICKEL ALLOY THIN FILM

TECHNICAL FIELD

The present invention relates to a nickel alloy sputtering target for forming a barrier layer and a nickel alloy thin film capable of inhibiting the diffusion of Sn as the component of a Sn solder or Sn-Pb solder between a substrate such as a semiconductor wafer or electronic circuit or a substrate layer or pad of the wiring or electrode formed thereon, and a Pb-free Sn solder or Sn-Pb solder bump formed thereon.

BACKGROUND ART

Generally, an aluminum or copper electrode or pad is formed on a semiconductor wafer or electronic circuit, or on the substrate thereof, and a conductive solder bump, Au bump, nickel bump or the like is additionally formed thereon. Among the above, a solder bump is the current mainstream material since it is easy to install and easy to repair.

Nevertheless, since an electrode substrate layer or pad formed from copper or the like easily reacts with a Pb-free Sn solder or Sn-Pb solder, after the solder bump is formed, there is a problem in that Sn diffusion will occur due to the heat arising in the manufacturing process or usage environment, a reaction will occur with the electrode substrate layer or pad formed from copper or the like as the substrate, and the characteristics will deteriorate due to the separation of the electrode layer or pad, or diffusion of the solder in the elements.

Due to the foregoing reasons, a proposal has been made for forming an intermediate barrier layer, via the sputtering method, capable of preventing the reaction between a substrate or an electrode substrate layer or pad formed from copper, and a Pb-free Sn solder or Sn-Pb solder bump.

A prerequisite of this intermediate barrier layer is that it has excellent adhesiveness with a substrate or a copper electrode substrate layer, and the wettability of the Pb-free Sn solder or Sn-Pb solder bump is excellent.

Nickel has been selected as this kind of material. Nevertheless, since nickel is a ferromagnetic material, it has inferior sputtering efficiency, and the nickel target must be made extremely thin in order to improve the sputtering efficiency. Thus, there is a problem in that the manufacture of this target is complicated, the target life is short, the target must be exchanged frequently, and, as a result, the manufacturing cost is increased.

Thus, a Ni-Cu alloy series film has been proposed as a material for reducing the magnetism of the Ni target and improving the sputtering efficiency (e.g., refer to Patent Document 1 and Patent Document 2). Nevertheless, this Ni-Cu alloy film does not necessarily have sufficient Sn barrier properties, and there is a problem in that it would react with the substrate film and increase electrical resistance.

As described above, since there is no sputtering target material capable of forming an effective barrier layer to become the intermediate layer with excellent solder wettability, when using a Pb-free Sn solder or Sn-Pb solder bump, problems often arise in that a reaction with the substrate or substrate copper layer would occur.

Meanwhile, in order to improve the adhesion with a ceramic substrate, a proposal has been made to use a nickel alloy target in which Mo, V and W are added to Ni (e.g., refer to Patent Document 3, Patent Document 4 and Patent Document 5). Further, a proposal has been made for using nickel alloy with Ti added thereto in order to improve the Sn barrier characteristics and to improve the etching characteristics (refer to Patent Document 6).

Nevertheless, although these are able to form a Ni alloy target and Ni alloy thin film, these are insufficient as a sputtering target capable of forming an effective barrier layer to become the intermediate layer with excellent solder wettability.

[Patent Document 1] Japanese Patent Laid-Open Publication No. S54-24231

[Patent Document 2] Japanese Patent Laid-Open Publication No. S56-110230

[Patent Document 3] Japanese Patent Laid-Open Publication No. 2000-169922

[Patent Document 4] Japanese Patent Laid-Open Publication No. 2000-169957

[Patent Document 5] Japanese Patent Laid-Open Publication No. 2000-169923

[Patent Document 6] Japanese Patent Laid-Open Publication No. 2001-11612

DISCLOSURE OF THE INVENTION

Thus, an object of the present invention is to provide a nickel alloy sputtering target and a nickel alloy thin film for forming a barrier layer having excellent wettability with the Pb-free Sn solder or Sn-Pb solder bump, and capable of inhibiting the diffusion of Sn being a soldering component and effectively preventing the reaction with the substrate layer upon forming a Pb-free Sn solder or Sn-Pb solder bump on a substrate such as a semiconductor wafer or electronic circuit or a substrate layer or pad of the wiring or electrode formed thereon; in particular, upon forming a Pb-free Sn solder or Sn-Pb solder bump on a substrate layer or pad formed from copper or copper alloy.

The present invention provides:

1) A nickel alloy sputtering target comprising 1 to 30at% of Cu; 2 to 25at% of at least one element selected from among V, Cr, Al, Si, Ti and Mo; remnant Ni and unavoidable impurities so as to inhibit the Sn diffusion between a solder bump and a substrate layer or a pad;

2) The nickel alloy sputtering target according to paragraph 1) above, wherein the nickel alloy is formed by adding at least one element selected from among V, Cr, Al, Si, Ti and Mo to Ni-Cu solid solution;

3) The nickel alloy sputtering target according to paragraph 1) or paragraph 2) above, wherein the solder bump is a Pb-free Sn solder or a Sn solder;

4) A nickel alloy thin film formed between a solder bump and a substrate layer or a pad, and comprising 1 to 30at% of Cu; 2 to 25at% of at least one element selected from among V, Cr, Al, Si, Ti and Mo; remnant Ni and unavoidable impurities;

5) The nickel alloy thin film formed between a solder bump and a substrate layer or a pad according to paragraph 4) above, wherein the nickel alloy is formed by adding at least one

element selected from among V, Cr, Al, Si, Ti and Mo to Ni-Cu solid solution;

6) The nickel alloy thin film formed between a solder bump and a substrate layer or a pad according to paragraph 4) or paragraph 5) above, wherein the solder bump is a Pb-free Sn solder or a Sn solder;

7) The nickel alloy thin film according to any one of paragraphs 4) to 6) above, further comprising a Cu-Sn intermetallic compound layer between a solder bump and a substrate layer or a pad;

8) The nickel alloy thin film according to paragraph 7) above, further comprising a 0.01 to 5μm Cu-Sn intermetallic compound layer between a solder bump and a substrate layer or a pad.

[Effect of the Invention]

The nickel alloy sputtering target for forming a barrier layer of the present invention and the nickel alloy thin film thereby yield superior effects of effectively inhibiting the diffusion of Sn as the component of a Sn solder or Sn-Pb solder between a substrate such as a semiconductor wafer or electronic circuit or a substrate layer or pad of the wiring or electrode formed thereon, and a Pb-free Sn solder or Sn-Pb solder bump formed thereon.

The present invention also yields a significant effect in possessing favorable soldering wettability, and facilitating magnetron sputtering due to its paramagnetism or feeble magnetism.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 shows the results upon measuring the strength in the depth direction of Sn with an Auger Electron Spectrometer from the Sn film side with respect to the deposition sample of Example 6; and

FIG. 2 shows the results upon measuring the strength in the depth direction of Sn with an Auger Electron Spectrometer from the Sn film side with respect to the deposition sample of Comparative Example 1.

BEST MODE FOR CARRYING OUT THE INVENTION

A barrier layer having excellent wettability with a Sn-Pb solder bump is formed with a Ni-Cu alloy series (hereinafter referred to as the "Ni-Cu alloy series") sputtering target of the present invention comprising 1 to 30at% of Cu; 2 to 25at% of at least one element selected from among V, Cr, Al, Si, Ti and Mo; remnant Ni and unavoidable impurities, and this is formed on a substrate such as a semiconductor wafer or electronic circuit or a substrate layer or pad of the wiring or electrode formed thereon; in particular, on a substrate layer or pad formed from copper or copper alloy.

By adding 2 to 25at% of at least one element selected from among V, Cr, Al, Si, Ti and Mo, the Curie point of Ni as a ferromagnetic material can be decreased linearly to realize paramagnetism.

Originally, Ni is a material with excellent solder wettability. Further, it also functions as a diffusion barrier of soldering to a certain degree. Nevertheless, since it is a ferromagnetic material, there is a problem in that it is extremely difficult to perform magnetron sputtering.

As a result of adding the foregoing V, Cr, Al, Si, Ti or Mo, magnetron sputtering is enabled, and a significant effect is yielded in that the productivity is improved. Although an addition of Cu itself also functions to reduce the magnetism of Ni, this is insufficient since large amounts of Cu must be added.

Incidentally, this barrier layer is not limited to a single layer, and may also be a composite layer with another material.

A Pb-free Sn solder bump or Sn-Pb solder bump is further formed on the barrier layer formed with the Ni-Cu alloy series sputtering target of the present invention, and the diffusion of Sn as the component of this solder bump can be effectively inhibited with the barrier layer of the present invention, and the reaction with the substrate or copper layer as the substrate layer can be effectively prevented.

The addition of 1 to 30at% of Cu to Ni has a Sn diffusion prevention function. Since Cu is exceptionally reactive to Sn in comparison to Ni, an intermetallic compound (Cu_6Sn_5, Cu_3Sn)

layer of Cu-Sn is formed between the solder via heat treatment. This layer exhibits an effect as a diffusion barrier.

The inhibition effect of Sn diffusion by this Ni-Cu alloy barrier layer is considered to be realized since the Sn movement and diffusion from the Pb-free Sn solder bump or Sn-Pb solder bump are prevented since Sn is already saturated in the Ni-Cu film as the intermediate barrier.

If this Cu-Sn intermetallic compound layer is too thick, cracks will easily occur and cause the dropout or separation of the solder. Further, if this is too thin, it will lose its function as the barrier layer, and it is desirable that the thickness is generally 0.01 to 5μm.

Moreover, this Ni-Cu alloy barrier layer is characterized in that it possesses extremely excellent wettability with the Pb-free Sn solder bump or Sn-Pb solder bump as described above.

As the component of the nickel alloy sputtering target for forming the Ni-Cu alloy barrier layer, 1 to 30at% of Cu is required.

If this amount is less than 1at%, the Cu-Sn intermetallic compound (Cu_6Sn_5, Cu_3Sn) layer cannot be sufficiently formed, and the effect as a diffusion barrier cannot be exhibited. Further, if Cu exceeds 30at%, the Cu-Sn intermetallic compound layer will be formed thicker and cracks will occur easily. Thus, it is necessary to keep Cu at 30at% or lower.

Meanwhile, 2 to 25at% of at least one element selected from among V, Cr, Al, Si, Ti and Mo must be added in the Ni-Cu alloy series of the present invention. If the additive amount is less than 2at%, the Curie point cannot be decreased sufficiently, the magnetism of Ni as a ferromagnetic material will be maintained, and the magnetron sputtering efficiency for forming the thin film layer will be inferior. Further, if the additive amount exceeds 25at%, the effective functions of Ni such as solder wettability and etching property will deteriorate.

As the target, since a single phase of metallographic structure is preferable, it is necessary to inhibit the additive amount of the respective added elements and the solid solution area of Ni. If the structure becomes a two-phase structure or greater, there is a problem in that particles will arise during sputtering.

The nickel alloy target for forming a barrier layer of the present invention may be formed with the ingot method; that is, subjecting the Ni-Cu alloy series to melting, casting, forging, rolling

and other processes to form the target. With an ingot target, Cu in the alloy exists as a solid solution.

Further, the nickel alloy target for forming a barrier layer of the present invention may also be formed with powder metallurgy. Here, it would be effective to form a sintered nickel alloy target with nickel alloy powder prepared using a pulverization process such as the atomization method.

When using this kind of nickel alloy atomized powder, a sintered body having superior uniformity can be obtained. A target having better quality than a sintered target prepared with ordinary nickel powder, copper powder and powder of added elements can be obtained.

In the sintering process, for instance, a target is prepared with HP or HIP. This kind of nickel alloy sputtering target comprises a structure in which the Cu is a solid solution due to the composition and manufacture process.

With respect to the crystalline structure, it is desirable that the average grain size is 100μm or less. Thereby, a uniform barrier film can be formed.

In order to prevent the contamination of the semiconductor or other electronic components, it is desirable that the purity of nickel, copper and added elements to become the target raw material is 3N (99.9%) or higher, preferably 5N or higher.

[Examples]

Examples of the present invention are now explained. These Examples are merely illustrative, and the present invention shall in no way be limited thereby. In other words, the present invention shall only be limited by the scope of the present invention, and shall include the various modifications other than the Examples of this invention.

(Example 1 to Example 42)

A Ni block having a purity of 5N (99.999wt%) and Cu having a purity of 4N (99.99wt%) and V shot were used as the raw material. 1600g of Ni was melted with a vacuum high-frequency induction furnace having a water-cooled copper crucible in a vacuum atmosphere. Cu and the added elements shown in Table 1 were added in small portions, and melted to ultimately become the alloy composition shown in Table 1.

This was tapped at a molten metal temperature of 1500°C to prepare a cast ingot. This ingot was subject to hot forging and hot rolling at less than 800°C to 1130°C. This was further subject to machining to prepare a target of ϕ 80mm × thickness of 10mm. The list of compositions of Cu, added elements (V, Cr, Al, Si, Ti, Mo) and remnant Ni of the nickel alloy target is shown in Table 1.

(Comparative Example 1)

A Ni block having a purity of 5N and Cu shot having a purity of 4N were used as the raw material. 1600g of Ni was melted with a vacuum high-frequency induction furnace having a water-cooled copper crucible in a vacuum atmosphere. Cu was added in small portions, and melted to ultimately become Ni-50at%Cu.

This was tapped at a molten metal temperature of 1400°C to prepare a cast ingot. As with Example 1, this ingot was subject to plastic working through hot forging and hot rolling to prepare a target.

(Comparative Example 2)

A Ni block having a purity of 5N and Cu shot having a purity of 4N were used as the raw material. 1600g of Ni was melted with a vacuum high-frequency induction furnace having a water-cooled copper crucible in a vacuum atmosphere. Cu was added in small portions, and melted to ultimately become Ni-2at%Cu.

This was tapped at a molten metal temperature of 1500°C to prepare a cast ingot. As with Example 1, this ingot was subject to plastic working through hot forging and hot rolling to prepare a target.

(Comparative Example 3)

A Ni block having a purity of 5N and V shot having a purity of 4N were used as the raw material. 1600g of Ni was melted with a vacuum high-frequency induction furnace having a water-cooled copper crucible in a vacuum atmosphere. V was added in small portions, and melted to ultimately become Ni-5at%V.

This was tapped at a molten metal temperature of 1500°C to prepare a cast ingot. As with Example 1, this ingot was subject to plastic working through hot forging and hot rolling to

prepare a target.

(Comparative Example 4)

A Ni block having a purity of 5N and Cu shot having a purity of 4N were used as the raw material. 1600g of Ni was melted with a vacuum high-frequency induction furnace having a water-cooled copper crucible in a vacuum atmosphere. Cu and V were added in small portions, and melted to ultimately become Ni-40at%Cu-5at%V.

This was tapped at a molten metal temperature of 1400°C to prepare a cast ingot. As with Example 1, this ingot was subject to plastic working through hot forging and hot rolling to prepare a target.

(Comparative Example 5)

A Ni block having a purity of 5N and Cu shot having a purity of 4N were used as the raw material. 1600g of Ni was melted with a vacuum high-frequency induction furnace having a water-cooled copper crucible in a vacuum atmosphere. Al and V were added in small portions, and melted to ultimately become Ni-5at%Al-5at%V.

This was tapped at a molten metal temperature of 1400°C to prepare a cast ingot. As with Example 1, this ingot was subject to plastic working through hot forging and hot rolling to prepare a target.

The list of compositions of the nickel alloy target of Comparative Examples 1 to 5 is similarly shown in Table 1 in comparison to Examples 1 to 42.

[Table 1] Nickel Alloy (at %)

		Cu	Added Elements (V, Cr, Al, Si, Ti, Mo)	Ni
Example	1	10%	5%V	Remnant
Example	2	10%	3%Al, 3%Cr	Remnant
Example	3	10%	3%Si, 3%Ti, 2%Mo	Remnant
Example	4	20%	6%Cr	Remnant
Example	5	7%	6%Al	Remnant
Example	6	25%	3%Si	Remnant
Example	7	5%	20%V	Remnant
Example	8	10%	10%V	Remnant
Example	9	30%	5%V	Remnant
Example	10	30%	10%V	Remnant
Example	11	2%	2%Cr	Remnant
Example	12	2%	25%Cr	Remnant
Example	13	15%	25%Cr	Remnant
Example	14	25%	2%Cr	Remnant
Example	15	25%	25%Cr	Remnant
Example	16	7%	23%Al	Remnant
Example	17	20%	12%Al	Remnant
Example	18	20%	23%Al	Remnant
Example	19	30%	12%Al	Remnant
Example	20	30%	23%Al	Remnant
Example	21	5%	5%Si	Remnant
Example	22	5%	20%Si	Remnant
Example	23	10%	5%Si	Remnant
Example	24	10%	20%Si	Remnant
Example	25	30%	20%Si	Remnant
Example	26	2%	12%Ti	Remnant
Example	27	2%	24%Ti	Remnant
Example	28	15%	12%Ti	Remnant
Example	29	15%	24%Ti	Remnant
Example	30	25%	12%Ti	Remnant
Example	31	25%	24%Ti	Remnant
Example	32	5%	5%Mo	Remnant
Example	33	5%	20%Mo	Remnant
Example	34	10%	5%Mo	Remnant
Example	35	10%	20%Mo	Remnant
Example	36	30%	5%Mo	Remnant
Example	37	30%	20%Mo	Remnant
Example	38	10%	5%V, 5%Si	Remnant
Example	39	10%	3%Mo, 7%Ti	Remnant
Example	40	15%	6%Si, 3%Mo, 2%Cr	Remnant
Example	41	27%	8%Mo, 2%Si	Remnant
Example	42	27%	4%Al, 6%Ti, 2%Mo	Remnant
Comparative Example	1	50%		Remnant
Comparative Example	2	2%		Remnant
Comparative Example	3		5%V	Remnant
Comparative Example	4	40%	5%V	Remnant
Comparative Example	5		5%V, 5%Al	Remnant

(Wettability Evaluation Test with Sn-Pb (Sn: Pb = 4: 6) Solder)

After forming a Ti film of 1000Å on a Si substrate with magnetron sputtering, the targets of Examples 1 to 42 and Comparative Examples 1 to 5 were used to form a Ni alloy film of 4000Å with magnetron sputtering.

A Sn-Pb (Sn: Pb = 4: 6) soldering ball having a diameter of 0.60mm was placed on this sputtered film, heated to 240°C in the atmosphere, and the spread in the diameter of the soldering ball was measured.

As a result, in Examples 1 to 42 of the present invention, the average diameter of the heated soldering ball was within the range of 0.76 to 1.36mm, and it is evident that the wettability with the Sn-Pb solder is excellent.

Contrarily, with Comparative Example 3 and Comparative Example 5, the solder wettability was somewhat defective.

(Sn Diffusion Evaluation Test)

After forming a Ti film on a Si substrate with sputtering, the targets of Examples 1 to 42 and Comparative Examples 1 to 5 were used to respectively form a Ni alloy film of 5000Å with sputtering.

Thereafter, a Sn target was used to form a Sn film of 3000Å, and retained in a vacuum at 250°C for 3 minutes. Then, the deposition sample was cut into a prescribed size, the strength in the depth direction of Sn was measured with the Auger Electron Spectrometer from the Sn film side, and the diffusion pattern was observed.

As a result, each of the Examples 1 to 42 was able to inhibit the diffusion of Sn to be low. Further, the magnetron sputtering characteristic was also excellent. Contrarily, Comparative Examples 1 to 5 showed significant diffusion of Sn.

As a representative example, the Auger measurement results of Example 6 and Comparative Example 1 are shown in FIG. 1 and FIG. 2. In FIG. 1 and FIG. 2, the horizontal axis represents the sputtering time, and the vertical axis represents strength. The interface of the Sn/Ni alloy film is considered to be around the sputtering time of 40 to 50 minutes.

In FIG. 1 of Example 6, with 40 to 50 minutes being the boundary, the existence of Sn is decreasing rapidly, and this signifies that the diffusion of Sn is being inhibited. Contrarily, in FIG.

2 of the Comparative Examples, large amounts of Sn were still detected even after sputtering was performed for 40 to 50 minutes, and this signifies that Sn was dispersed in such amount internally.

Further, with Comparative Example 1, although the solder wettability was favorable and the diffusion of Sn was inhibited, there was a problem in that microcracks occurred.

In Comparative Example 2, although the solder wettability was favorable, the diffusion of Sn was significant and lost its effect as a barrier layer. Moreover, there was a problem regarding the stability of plasma.

In Comparative Example 3, the solder wettability was somewhat inferior, and magnetron sputtering deteriorated significantly. Further, the diffusion of Sn was significant, and there was not effect as a barrier layer.

In Comparative Example 4, although the solder wettability and sputtering characteristic were favorable, the barrier properties were inferior and cracks occurred.

In Comparative Example 5, although there was no generation of cracks, the solder wettability was somewhat defective, the barrier properties were also inferior, and the sputtering characteristic was also somewhat inferior.

Contrarily, as described above, with the Examples of the present invention, the barrier properties were superior, and the solder wettability, crack resistance properties and sputtering characteristics all excellent, and it is evident that a superior nickel alloy target has been provided. Results of the foregoing evaluation test are shown in Table 2.

[Table 2]

		Solder Wetability	Barrier Properties	Cracks	Sputtering Characteristic
Example	1	Excellent	Superior	None	Excellent
Example	2	Excellent	Superior	None	Excellent
Example	3	Excellent	Superior	None	Excellent
Example	4	Excellent	Superior	None	Excellent
Example	5	Excellent	Superior	None	Excellent
Example	6	Excellent	Superior	None	Excellent
Example	7	Excellent	Superior	None	Excellent
Example	8	Excellent	Superior	None	Excellent
Example	9	Excellent	Superior	None	Excellent
Example	10	Excellent	Superior	None	Excellent
Example	11	Excellent	Superior	None	Excellent
Example	12	Excellent	Superior	None	Excellent
Example	13	Excellent	Superior	None	Excellent
Example	14	Excellent	Superior	None	Excellent
Example	15	Excellent	Superior	None	Excellent
Example	16	Excellent	Superior	None	Excellent
Example	17	Excellent	Superior	None	Excellent
Example	18	Excellent	Superior	None	Excellent
Example	19	Excellent	Superior	None	Excellent
Example	20	Excellent	Superior	None	Excellent
Example	21	Excellent	Superior	None	Excellent
Example	22	Excellent	Superior	None	Excellent
Example	23	Excellent	Superior	None	Excellent
Example	24	Excellent	Superior	None	Excellent
Example	25	Excellent	Superior	None	Excellent
Example	26	Excellent	Superior	None	Excellent
Example	27	Excellent	Superior	None	Excellent
Example	28	Excellent	Superior	None	Excellent
Example	29	Excellent	Superior	None	Excellent
Example	30	Excellent	Superior	None	Excellent
Example	31	Excellent	Superior	None	Excellent
Example	32	Excellent	Superior	None	Excellent
Example	33	Excellent	Superior	None	Excellent
Example	34	Excellent	Superior	None	Excellent
Example	35	Excellent	Superior	None	Excellent
Example	36	Excellent	Superior	None	Excellent
Example	37	Excellent	Superior	None	Excellent
Example	38	Excellent	Superior	None	Excellent
Example	39	Excellent	Superior	None	Excellent
Example	40	Excellent	Superior	None	Excellent
Example	41	Excellent	Superior	None	Excellent
Example	42	Excellent	Superior	None	Excellent
Comparative Example	1	Excellent	Inferior	Cracks	Excellent
Comparative Example	2	Excellent	Inferior	None	Defective
Comparative Example	3	Somewhat Defective	Inferior	None	Excellent
Comparative Example	4	Excellent	Inferior	Cracks	Excellent
Comparative Example	5	Somewhat Defective	Inferior	None	Somewhat Defective

[Industrial Applicability]

The present invention yields a significant effect in that it has excellent wettability with a Pb-free Sn solder or Sn-Pb solder bump, and capable of inhibiting the diffusion of Sn being a component of the Pb-free Sn solder or Sn-Pb solder and effectively preventing the reaction with the substrate layer. Further, since the nickel alloy target of the present invention has paramagnetism or feeble magnetism, the present invention also yields a significant effect in that magnetron sputtering can be performed easily.

Therefore, the nickel alloy sputtering target and nickel alloy thin film of the present invention are useful as a barrier layer of a solder bump to be formed on a substrate such as a semiconductor wafer or electronic circuit, or a substrate layer or pad such as a wiring or electrode formed on such substrate.